Spatial Patterns of Macroinvertebrates on the Upper Mississippi River System

by

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The most widespread annual collections of benthic (bottom dwelling) macroinvertebrates in the Upper Mississippi River System (UMRS) are now being made as part of the Long Term Resource Monitoring Program (LTRMP). Long-term monitoring is necessary to better understand the conditions needed to support viable macroinvertebrate populations at levels adequate to sustain native fish and migrating waterfowl. In 1992, the long-term monitoring of select taxa began in Pools 4, 8, 13, 26 and the Open River Reach of the Upper Mississippi River and in La Grange Pool of the Illinois River. Mayflies (Ephemeroptera), fingernail clams (Sphaeriidae), and Asiatic clams (*Corbicula sp.*) were first selected for sampling, followed by midges (Chironomidae) in 1993, and zebra mussels (*Dreissena polymorpha*) in 1995.

Mayflies, fingernail clams, and midges were selected for monitoring because they have traditionally been used as biological indicators of river water quality and are important components of the aquatic ecosystem. They perform the valuable ecological functions of digesting organic material and recycling nutrients, in addition to being an important food source for a number of waterfowl and fish species. The exotics, Asiatic clams and zebra mussels, were chosen because of their potential detrimental impact to the economy and biology of the UMRS.

Sampling was based on a stratified random design selected for estimating mean densities of benthic macroinvertebrates within aquatic area strata of each study area. Samples were collected yearly at approximately 125 sites per study reach using a winch-mounted standard Ponar grab sampler designed for sampling macroinvertebrates from the substrate. More than 4,000 Ponar collections were made from the six study reaches during the summers of 1992, 1993, 1994, 1995, 1996, and 1997. No statistically significant linear trend existed in the overall mean densities of mayflies ($P = 0.15$), fingernail clams ($P = 0.22$), or midges ($P = 0.94$) across years or the interaction between study areas and year ($P = 0.64$, $P = 0.94$, $P = 0.24$, respectively). However, the overall test for differences in estimated mean densities of mayflies, fingernail clams, and midges were statistically significant among study areas ($P < 0.05$).
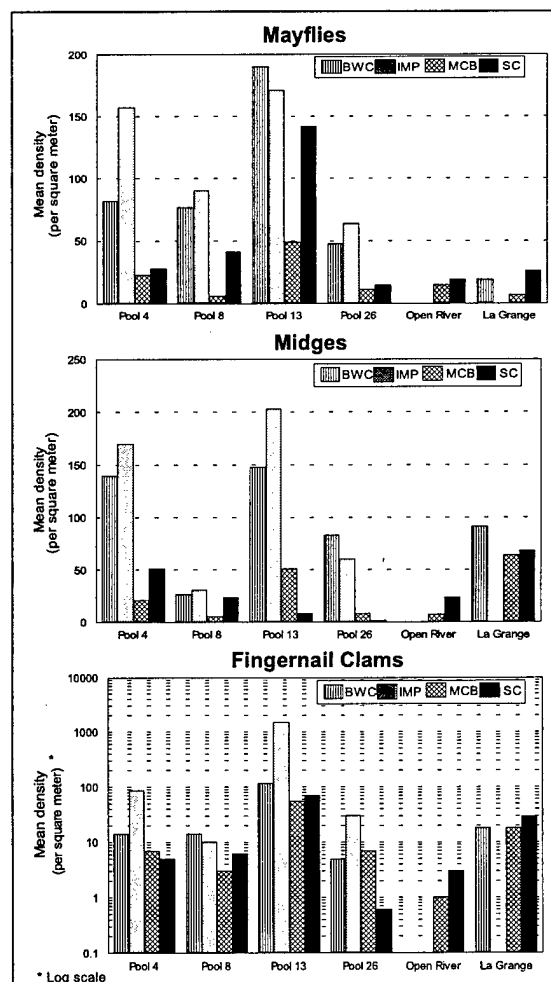

Figure 1. Mean densities of select macroinvertebrates in backwater contiguous (BWC), impounded (IMP), main channel border (MCB) and side channel (SC) aquatic areas of the UMRS, 1992-1997.
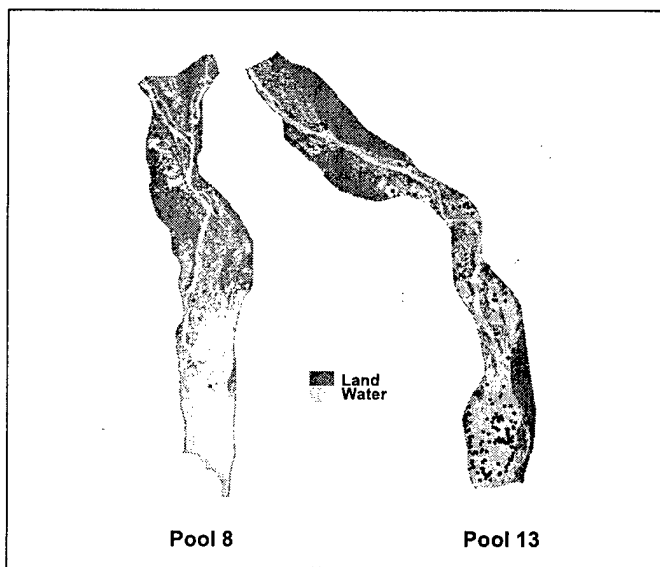
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Figure 2. UMRS sample sites having 20 or more fingernail clams per sample; 1992-1997.

Figure 3. UMRS sample sites having 20 or more mayflies per sample; 1992-1997.

The mean densities of taxa varied over the years among aquatic areas. Overall, the greatest densities of mayflies and midges were found in the backwater contiguous and impounded aquatic areas of Pools 4, 8, 13 and 26, including the naturally impounded Lake Pepin in Pool 4. The greatest densities of fingernail clams were observed in the impounded aquatic areas of Pools 4, 13, and 26. However, in the Open River Reach and La Grange Pool, the highest mayfly and fingernail clam densities were found in the side channels (Figure 1).

The densities of mayflies, fingernail clams, and midges captured in LTRMP sampling are well within the ranges reported by past studies on the UMRS. A previous study in the 1960's found density ranges from zero to 1,114 per square meter (m^{-2}) for *Hexagenia* mayflies and from 237 m^{-2} to 7,570 m^{-2} for fingernail clams in Pool 19. Fingernail clam populations in several backwater lakes in Pool 9 varied from 631.8 m^{-2} in 1976 to 11.3 m^{-2} in 1989 and then increased to 78 m^{-2} in 1990. Midge densities greater than 4,000 m^{-2} were found in a backwater lake in Pool 2 in the 1980's. Data from the LTRMP sampling effort show density ranges from zero to 1615.4 m^{-2}, 27,615 m^{-2}, and 4,000 m^{-2} for mayflies, fingernail clams, and midges; respectively.
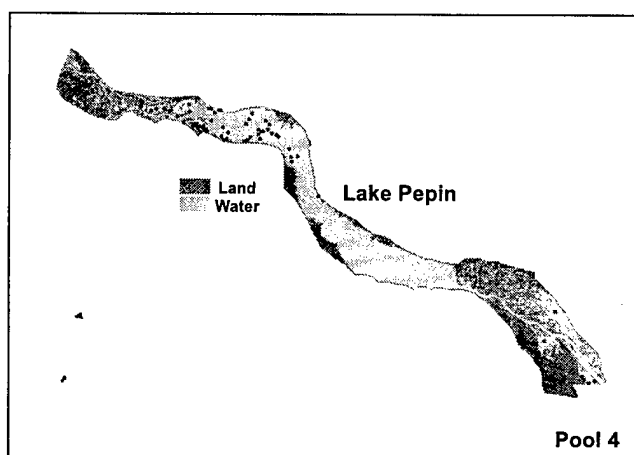
A geographic information system (GIS) is being used to view and analyze the LTRMP spatial data. The integration of monitoring data with spatial databases will assist scientists in determining spatial distributions and help explain causal relationships. Although the integration of monitoring data and spatial databases is just beginning, simple mapping of the numbers of taxa from Ponar sampling vividly shows the spatial distribution within a study area and differences among study areas (Figures 2 and 3). ❑

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February 1998

PSR 98-02